

PROJECT 3 OVERVIEW

Common Denominators for Transportation Safety Evaluations

INTRODUCTION

Background

Transportation safety statistics are often reported as rates of events, such as crashes or deaths per some unit of activity (often called exposure). The type of exposure information used to calculate these rates varies greatly and is often specific to the type or mode of transportation system being evaluated. This mode-specific characteristic makes comparisons of the relative safety of different transportation modes very difficult. Consequently, transportation safety practitioners, policymakers, and the public often have difficulty accurately comparing the safety performance of different transportation modes.

In September of 2000, the Bureau of Transportation Statistics (BTS) of the U.S. Department of Transportation (DOT) initiated a project called the Safety Data Action Plan. The goal of the plan was to develop an approach to improve the quality of safety data throughout DOT. BTS identified 10 subject areas that would benefit from a focused effort to improve the quality of transportation safety data and information.

One of these topics was the development of common denominators for safety measures. The problem was defined as “Each mode uses a different set of denominators (*exposure measures*) for evaluating changes in safety risk” (Safety Data Action Plan).

The plan authors further observed “We need some set of common denominators that can be used to characterize transportation safety in a comparable way for comparable circumstances. It should be possible to compare the risk of recreational boating, for example, to the risk of recreational flying or recreational driving.”

While there are limitations to identifying cross-modal exposure measures, the potential benefits from such an effort are many. For example, having a common frame of reference for transportation safety metrics will allow researchers and policymakers to conduct evaluations that provide insight on some of the following issues:

- the overall safety of the transportation system;
- relative safety of different modes;
- comparison of the effectiveness of safety interventions for different modes;
- focus areas for research and/or funding; and
- strategic planning for transportation agencies including federal, state, and municipalities.

Objective

The objective of this project is to identify common denominators suitable for safety evaluations and comparisons within and

across various transportation modes (aviation, recreational boating, commercial fishing, etc.). Numerous factors will be considered, including the suitability of current exposure measures for cross mode comparisons, the possible need to develop new measures, and the methods required to develop these new measures.

GENERAL APPROACH

The project involved two main steps: baseline determination of current exposure measure characteristics and evaluation of cross-mode suitability of the exposure measures.

Baseline Determination

- Current exposure measures used in transportation safety evaluations were indexed and cataloged.
- Limitations and gaps associated with the current exposure measures were identified.
- Potential improvements in current exposure measure data systems were identified.

Cross Mode Exposure Measures

- Suitable, and unsuitable, cross mode comparisons were identified.
- Exposure measures needed to support these comparisons were identified.
- Recommendations for the use of exposure measures suitable for intra- and intermode comparisons were made including the development of new measures where appropriate.
- Approaches for implementing findings and recommendations were identified.

Scope

The scope of this project is limited to evaluation of exposure measures suitable for use in transportation safety related evaluations (both inter- and intramode). Primary attention was paid to U.S. DOT based data systems, although those data systems commonly used for exposure data maintained by non-DOT organizations are also included. Exposure measures for the following modes were considered:

- aviation,
- highway,
- railroad,
- transit,
- water, and
- pipeline.

Note: The working group for this project was concerned about defining what constitutes a transportation related occupational injury or death. This would have a direct impact on the exposure measures used for evaluating such injuries. Consequently, the Project 3 working group applied the scope definition used by the Project 5 and Project 2 working groups. Specifically, exposure measures were considered that were useful for rate calculations of transportation crashes or mishaps. The definition of crash and mishap was defined as:

- any incident involving the movement or operation of a vehicle, vessel, aircraft, pipeline, or other conveyance in the course of conveying persons or goods from one place to another;
- occurs within U.S. jurisdiction or involves a U.S. commercial carrier;
- is intention or unintentional; and
- results in substantial property damage or injury (requiring medical attention beyond first aid) or death within 30 days (e.g., passengers,

crew, pedestrians, other workers, or bystanders).

Information Sources

Data Sources

Exposure information is sometimes derived from data sources not originally designed for transportation safety analyses. An example might be the use of information derived from the registrations for recreational boats. Submittal of these data are required from each of the 50 states. The data is then collected by the U.S. Coast Guard and used for safety evaluations. The difficulty with this exposure data source is that individual states have different registration requirements and data may vary considerably. Further, this exposure source does not provide information on the activity associated with the boats. That is, how are the boats used, by whom, and so on? Finally, there is no federal control of boat registration, and thus changing the system to produce better exposure information will be difficult, as will be the case with other sources of exposure data (e.g., automobile registrations and licensed driver registries).

In contrast to the boat registration database, other sources of exposure data are specifically designed for use in safety evaluations. An example of this is the General Aviation and Air Taxi Survey conducted by the Federal Aviation Administration on a yearly basis. This survey collects information from a sample of aircraft owners who provide information on how the aircraft is used, how often it is flown, and how it is equipped, plus many other types of information that prove useful to analysts and policymakers.

For this project, the primary source of the exposure data is collected and maintained by the following government organizations.

U.S. Department of Transportation

Federal Aviation Administration (FAA)
Bureau of Transportation Statistics (BTS)
Surface Transportation Board (STB)
Federal Railroad Administration (FRA)
U.S. Maritime Administration (MARAD)
United States Coast Guard (USCG)
Federal Highway Administration (FHWA)
Federal Transit Authority (FTA)
Research and Special Projects
Administration (RSPA)

Other Federal Agencies

National Institute for Occupational Safety and Health (NIOSH)
U.S. Army Corps of Engineers
U.S. Census Bureau

Most of the exposure databases maintained by these organizations were evaluated by DOT's Volpe National Transportation Systems Center (Berk) and summarized in a report to support this project.

Expert Panel

In addition to the information provided by Volpe and the various government agencies, an expert panel of experienced transportation safety practitioners, researchers, and government representatives provided considerable input on the focus of the project and the associated recommendations.

Consideration of Approach

Initially, the working group assigned to this project spent a significant amount of time conceptualizing how cross modal comparisons would work. This became one of the first steps undertaken because the working group had little experience in using common exposure measures for comparisons across modes. Review of the relevant literature and comparison of the experience among the working group members demonstrated that such

comparisons appear to be somewhat uncommon.

Traditionally, transportation safety statistics are reported and compared within modes. Typical statistics arising out of these comparisons might include reporting rates of events, perhaps over time so comparisons could be made of the increase or decrease of unwanted events. In order to understand how cross modal comparisons might be used, a sample of potential questions or comparisons was derived from input from BTS staff. Some of these ideas are listed below.

How Common Exposure Measures Might Be Used

- Allocating research resources across modes (and across federal programs in general).
- Making modal choices for travel among the public (where there are logical choices to made (e.g., long automobile trips or bus trips versus airline travel).
- Identifying especially risky transportation occupations or activities.
- Monitoring overall transportation system safety performance and targeting interventions where the most benefit might be expected.
- Strategic planning for DOT and other governmental transportation authorities.
- Support for rulemaking.

Review of the various exposure databases shows a large variation in how data are collected and used. Because of these many differences, it is inappropriate to expect a single set of exposure measures might to be suitable for all transportation modes. It may be that simple exposure measures (e.g., number of people transported by a mode)

are useable for cross-mode evaluations, but this measure may not be very informative. If efforts are made to find exposure measures that are more specific, such as the number of hours flown by a pilot during a fixed time frame, the applicability across the various modes seem to rapidly diminish.

In addition, it is clear that cross-modal exposure measures are only needed where there are meaningful cross-modal comparisons of risk. For example, the working group could not think of meaningful comparisons of say, the risk of flying on a commercial airliner versus the risk of riding in a recreational sailboat. In like fashion, it is clear that cross-modal exposure measures between two or more modes might change based on the risk question being asked. For example, the risk to freight between air and highway modes might require a different exposure measure than the risk to the operators of the freight carriers in the two modes.

Based on these considerations, the working group decided to apply a simple conceptual model applicable to all modes to help determine what types of cross modal exposure data might be valid and useable. There were four main categories (each with multiple subgroupings) included in this model.

Cross Modal Categories for Exposure Data

The four groupings used by the working group were associated with the underlying purpose of the transportation activity:

1. *Recreational use:* Includes activities such as pleasure boating, recreational flying, and recreational driving.
2. *Cargo and material transportation:* Includes transportation of cargo and materials by airplane, truck, pipeline, and water.

3. *Passenger transportation*: Includes all activities involving passenger transportation, both commercial and private.
4. *Occupational and Harvesting*: Includes occupational activities such as commercial fishing, truck driving, flying, etc.

These categories are not mutually exclusive, but they provide a starting point for discussing suitability of cross modal comparisons.

DISCUSSION OF CROSS MODAL EXPOSURE MEASURES

Working group 3 identified potential exposure measures that could be applied across modes. In some cases, these exposure measures are derived from current exposure data systems while in others, new data collection efforts might have to be undertaken.

As mentioned earlier, the results from the working groups' discussion on exposure measures suitable for cross modal evaluation are organized by the function of the transportation activity. These groups are passenger transportation, freight transportation, recreational use, and occupational activities.

Passenger Transportation

Modes involved in passenger transportation include aviation, highway, transit, maritime, and rail. The working group was also asked to consider walking and bicycling, but decided that only bicycling was suitable for inclusion in this evaluation of exposure measures. Exposure measures identified by the working group that might be of use are included below. Some of these exposure values are derived from actual measures (from surveys or required reports) while others are calculated from measures that are reported:

- person miles traveled (calculated),
- person hours of travel (calculated),
- average trip length in miles (measured),
- average trip length in time (measured),
- number of occupants in vehicle (measured),
- number of people using that mode of transportation per year (measured), and
- number of licensed drivers/operators (measured).

Freight Transportation

Modes involved in freight transportation include aviation, highway, maritime, rail, and pipeline. It should be noted that transportation of materials by pipeline is very different than transportation of most other freight. This characteristic caused a fair amount of discussion among working group members who had difficulty identifying common exposure measures for freight that would also include pipeline. Exposure measures identified by the working group that might be of use include:

- ton miles,
- cube miles,
- trip length in miles,

- trip length in time (these two values would allow speed values to be calculated),
- number of licensed drivers/operators,
- volume of materials transported,
- person miles traveled (calculated), and
- person hours of travel (calculated).

Occupational Transportation Exposure Measures

The working group felt strongly that the quality of occupational exposure data in the transportation industry must be improved. The group, however, had a difficult time determining which groups should be considered transportation workers. As discussed earlier in this paper, the working group decided that occupational-related exposure data should be limited to the actual operation of the vehicle. Support functions such as maintenance, loading, and other activities where the vehicle is stationary would not be included. It should be noted, however, that many occupational groups such as truck drivers, pilots, and others have responsibilities other than just operating their vehicles. These individuals may be required to load and unload trucks, wait for loading, and so on. These activities are considered part of the driver's work time (often called duty time) but are not typically recognized when measuring vehicle operation. This is critical if safety evaluations examine operator fatigue or circadian rhythm disruption. With this limitation in mind, occupational groups would include vehicle operators and crewmembers. It is also appropriate that individuals who rely on their personal vehicles to perform their jobs be included in this group.

There is some discrepancy in the group's definition with respect to occupational

exposure to workers maintaining the "facility." Here, highway transportation is considered somewhat unusual in that facility maintenance and development is done in the presence of moving vehicles (i.e., in highway work zones). This is not true (at least to the same extent) for other modes. Because of this difference, this group is not included here. The working group also decided to include commercial fisherman since they are dependent on the fishing vessel, a form of conveyance, for their livelihood.

Exposure measures identified by the working group for transportation worker exposure databases that might be suitable for cross mode evaluation include the following:

- hours on duty,
- person hours operating the vehicle,
- number of licensed drivers/operators,
- total number of individuals involved in that occupation, and
- active work zones in highway areas (including a measure of size i.e., length by number of lanes as well as a measure of amount of time in place).

Recreational Exposure Measures Suitable for Cross Modal Comparisons

The working group recognized that transportation related recreational activities are fairly common. The working group decided that recreational use of vehicles involved those activities associated with the pleasure of operating the vehicle—not using vehicles for transportation. Activities that might fit this profile included recreational

boating, recreational flying, recreational driving (for example, off- road exploration), and recreational bicycling. Common to all of these recreational uses of vehicles is the fact that traveling from one place to another is not the primary purpose.

Exposure measures identified by the working group for transportation related exposure measures that might be suitable for cross mode evaluation include the following:

- person hours operating the vehicle,
- total number of other participants involved in the recreational use of vehicles, and
- total number of vehicle occupants.

RECOMMENDATIONS

The following recommendations are based on the exposure data needed to support cross modal evaluations.

The general aviation activity survey should be expanded to collect information on the following topics:

- number of aircraft occupants;
- person miles traveled;
- trip length, miles;
- freight (ton miles); and
- hours on duty for professional pilots.

A program should be developed to capture the following types of information from commercial marine operators including commercial shippers and commercial fisherman. At this point, it is not clear if current data collection efforts for this group could be modified or if a new data collection program would need to be developed.

- trip length, miles;
- trip length, time;
- number of occupants or crew;
- hours on duty;

- person miles, stratified by position (crew, passenger, etc.); and
- person hours, stratified by position (crew, passenger, etc.).

The highway data collection efforts, HPMS, VIUS, NHTS, Transportation Annual Survey and Commodity Flow Survey should be reviewed to determine the accuracy of current estimates provided and their suitability for combination or modification to provide or enhance the following information for motor carriers.

- person miles traveled,
- person hours traveled,
- trip length,
- number of occupants,
- total number of trucks operated by commercial motor carriers,
- hours on duty for vehicle operators, and
- purpose of trip.

An ongoing and systematic survey should be undertaken to capture information from recreational boat operators on the following:

- person hours operating the boat;
- person hours on-board, including at anchor;
- total number of boat occupants;
- trip length, miles; and
- trip length, time.

The NHTS should be conducted more frequently to improve timeliness of information and modified to collect information on the following:

- recreational driving;
- recreational boating;
- person hours engaged in recreational driving;
- total number of occupants during recreation driving;
- recreational trip length, miles;
- recreational trip length, time; and

- increase frequency of survey to improve timeliness.

The Department of Transportation should work with State and other appropriate authorities to develop a central repository of demographic information derived from operating licenses and approvals. This would include:

- drivers' licenses,
- operator information for train and transit operators, and
- information on commercial marine operators.